Learning Strategies Used While Developing Motor Skill Assessment Competency

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Abstract

This study investigated the effectiveness of a web-based assessment training program and whether explicitly guiding the participants toward the recommended learning sequence would improve their performance on assessing the underhand roll compared to participants that were given free choice of their learning sequence. Participants were 48 volunteer pre-service undergraduate kinesiology majors from two universities that were randomly assigned to two treatment groups. The data collected on the participants included pre and post assessment scores, as well as program usage data: the frequency and time spent using each of the training program options. Results revealed a non-significant treatment effect was found between the two treatment groups, but significant overall pre to post performance gain of 24.4 percent (ES = .772). Program usage data revealed that participants with higher competency scores significantly used the guided practice option more frequently and for more time and overall used the program for more time than participants with lower competency scores.

Keywords: physical education, teacher training

A requisite of teaching motor skills (e.g., kicking a soccer ball, shooting a basketball) is the ability to accurately evaluate motor performance and identify what components are correctly performed and what errors are being made (Horvat, Block, & Kelly, 2007; Kelly, Wessel, Dummer, & Sampson, 2010). Research has indicated that physical education teachers are not proficient in motor skill assessment, and often performed no better than undergraduate students, coaches, or classroom teachers in assessing motor skills (Behets, 1996; Biscan & Hoffman, 1976; Hoffman & Sembiante, 1975; Imwold & Hoffman, 1983; Walkley & Kelly, 1989).

Physical education teacher education (PETE) programs have also been shown to be ineffective in teaching PETE students how to assess the performance of motor skills (Lounsbery & Coker, 2008; Pinheiro & Simon, 1992; Reeves, 2000). Typically, PETE programs assume that motor skill assessment skills are learned when pre-service students complete a theory-based course such as biomechanics or motor development (Hoffman, 1974; Lounsbery & Coker, 2008). However, research indicates that the theory-based knowledge of movement concepts do not transfer to motor skill assessment skills (Daniels, 1984; Knudson, Morrison, & Reeve, 1991).

Many barriers have been identified as to why motor skills are not effectively taught in the PETE curriculum, with one of the greatest barriers being time (Lounsbery & Coker, 2008). Pre-service students are limited by the amount of class time available and the number of courses available, in a typical PETE curriculum. As such, PETE students do not have adequate opportunities to become competent in each topic in their curriculum (Nielsen & Beauchamp, 1992). Specifically, motor skill assessment training is often limited to the teaching of concepts of qualitative assessment as opposed to motor skill assessment competency (Walkley & Kelly, 1989).

Computer-based instruction (CBI) has been found to be as effective, if not more effective, than traditional teacher-directed instruction in teaching foundational skills (Huang, Liu, & Chang, 2012; Jenks & Springer, 2002; Lee, Shen, & Tsai, 2008). The advantages of CBI over teacher-directed instruction are that it can be programmed to adjust the pace and path of instruction based on the needs of the learner, it can be accessed 24/7, it can provide immediate feedback, and it can manage and record the learners' performance. The effectiveness of CBI in education has been supported by several meta analyses reporting moderate effect sizes in favor of CBI. For example, Kulik and Kulik (1991) examined 254 studies on general use of CBI and found a moderate effect size (ES = 0.30) while Cohen and Dacanay (1992), examining 47 studies in CBI in health professions, reported an ES of 0.41. Additionally, a study by McNeil and Nelson (1991) with 63 studies involving interactive video and cognitive development found an ES of 0.53.

In response to the need for an innovative way to improve motor skill assessment training and the efficacy of CBI, the Motor Skill Assessment Program (MSAP) (Kelly, 2007) was developed. The MSAP is a web-based application that provides individualized motor skill assessment training designed based on behavioral and adult learning theory. Behavioral learning theory was selected because it provides alignment between appropriate learning strategies (i.e., cues, stimulus, response, feedback, and associations) and the desired goals of MSAP (i.e., foundational knowledge of correct motor skill assessment). Behaviorism is based on the basic principles of operant conditioning, and learning is associated with observable changes in behavior. Learning is demonstrated by a correct response after a particular stimulus is presented (Ertmer & Newby, 1993). The primary focus of behaviorism is "how the association between the stimulus and response is made, strengthened, and maintained" (Ertmer & Newby, 1993, p. 55). In behavioral learning theory, the presentation of the stimulus and resulting environmental consequence is key, as responses that are followed by reinforcement are more likely to be repeated in the future (Ertmer & Newby, 1993).

The user control and learning sequencing of MSAP were designed using adult learning theory (ALT), which proposes that adults have different learning needs than children, and therefore, programs must be designed to address their particular learning needs and characteristics (Cercone, 2008). ALT is based on five assumptions that address the difference between children and adults as learners: (a) self-concept of the adult learner is one of self-directed learning, (b) past experiences of the adult learner serve as a resource, (c) readiness to learning is related to changing social roles, (d) orientation to learning is problem-centered and

based on immediate application of knowledge, and (e) motivation to learning is by internal factors (Knowles, 1977, 1980; Merriman, 2001).

MSAP addresses each of the five assumptions of ALT in its design. For the first assumption, learners are able to choose and control options and the ways of progressing through the MSAP modules; resulting in self-directed learning opportunities. For the second assumption, learners' previous experiences of performing, teaching, and assessing motor skills are accounted for. Due to these past experiences, it is possible that the learner has a background and understanding of how to perform motor skills correctly. Therefore, learners can chose to view correct performances and errors of focal points if needed, but are not required to utilize these options if they have an understanding of the focal points from past experiences. The third assumption theorizes that adults are ready to learn new and required content to address their changing social roles. Adult learners will choose to use MSAP because they are at a point in their education where they need and understand the benefit of becoming proficient in motor skill assessment. The fourth assumption is that adults are motivated to learn if they perceive it will be applicable and will help them in their real-life situations. The MSAP was designed for use by individuals who have a need to correctly assess motor skills in their current or future professions, including physical educators, pre-service physical educators, and kinesiology majors. As motor skill assessment is necessary to provide best teaching practices, it is anticipated that these learners perceive that the ability to analyze movement patterns is directly applicable in their current or future professions. The fifth assumption was addressed through the design of MSAP in that adult learners would be motivated to use MSAP to improve their motor skill assessment because it would be intrinsically rewarding. Adult learners should be internally motivated to learn how to accurately assess motor skill performance and earn the highest score possible on the competency assessments because these are essential skills of the profession.

The MSAP recommended learning sequence (See Figure 1), based upon behavioral and ALT, would be that the learner would choose to maximize their efficiency by using the tutorial option to learn the focal points of the skill and to develop a mental image of what each focal point looked like when performed correctly as well as some of the common errors made on each focal point. Then the learner would use the MSAP guided practice option to develop and evaluate their assessment skills. The learner would refer back to the tutorial as needed if they consistently had trouble accurately assessing one or more of the focal points. Finally, when the learner could consistently and accurately assess practice clips in the guided practice option in three trials using only real speed, they would elect to evaluate their performance using the competency assessment option.

Figure 1. MSAP recommended learning sequence

Recommended Learning Sequence

- Learn the Skill
  - o Use the Tutorial option to learn the focal points of the skill so you can observe them without referring back to the prompts.
  - o Use the Tutorial option until you have a mental image of what the correct focal point performances look like.
  - o Review the common errors for each focal point until you understand what the common errors look like.
- Practice
  - o Use the Guided Practice option until you can consistently and accurately assess students.
  - o Start by practicing in slow motion and view the clip as many times as needed until you can make an accurate judgment.
  - o As you practice, identify problem areas and review the tutorial on these focal points.
  - o As your assessing skill increases, gradually limit your practice to real speed and three trials. When you can consistently score over 90% using these options, proceed to the Competency Assessment option.
- Competency Assessment
  - o The goal of MSAP is to develop your assessment skills so that when you take the Competency Assessment you do very well - score in the 90's.
  - o The Competency Assessment can ONLY be taken 3 times, therefore to maximize your performance you should only select this option after you have consistently scored well using the Guided Practice option.
  - o The Competency Assessment is composed of 10 underhand roll clips. Each clip can be viewed a maximum of 3 times and only in real speed to simulate actual assessment conditions in the field.
  - o At the end of the Competency Assessment you will be given a report that shows your overall accuracy as well as your accuracy on each focal point.

To date, two studies have investigated the effectiveness of MSAP. Kelly and Moran (2010) found that MSAP training produced a significant pre to post improvements in assessment competency and was as effective as teacher-directed training for 72 pre-service physical education majors. Kelly, Taliaferro, and Krause (2012) investigated whether assessment competency acquired via MSAP generalized to accurately assessing live students in a gymnasium setting. The findings revealed that 36 pre-service kinesiology majors performed significantly better from pre to post (ES = .91) on assessing a motor skill after training using MSAP and this training transferred to significant improvements (ES = .80) in accurately assessing actual students in a gymnasium setting. While these results were very positive, the authors noted that informal observations and conversations with some of the participants suggested that they may not have been using the most efficient learning strategies as suggested by adult learning theory. Based on these previous studies, the current study was designed to address three research questions. The first question was to confirm the effectiveness of MSAP training and to evaluate whether MSAP training produced similar findings as reported in previous studies. The second question examined whether explicitly guiding the participants toward the recommended learning sequence would improve their assessment performance of the underhand roll. The third question examined how the participants used the MSAP options (e.g., tutorial, guided practice, and competency assessment) and how this usage corresponded to their overall performance on

assessing the underhand roll. This study is significant because it evaluates the validity of ALT and whether preservice students act according to ALT when they employ the MSAP training options to learn how to assess motor skills.

Method

Participants

The participants were a convenience sample of 48 (19 males and 29 females) volunteer pre-service undergraduate kinesiology majors (age: M = 20.54 years, SD = 1.56) attending two universities in the southeast United States. With regard to the number of hours of physical education teaching experience, the participants reported little prior teaching experience: 91.7% reported 0-20 hours, 6.3% reported 21-50 hours, and 2.0% reported 51-100 hours. When asked about prior training in assessing motor skills, 2.0% reported no prior training, 62.5% reported 1-10 hours, 29.2% reported 11-25 hours, and 6.3 % reported 26+ hours of training. When asked how important they felt it was for physical educators to be competent in assessing motor skills 2.0% reported they were unsure, 25.0% reported it was important, and 73.0% reported it was very important. When asked how comfortable they were using technology 2.0 reported being uncomfortable, 25.0% reported being unsure, 60.4% reported being comfortable, and 12.6% reported being very comfortable. Finally, when asked how competent they currently felt assessing motor skills, 2.0% reported no competency, 27.1% reported being not competent, 39.6% reported being unsure of their competency, and 31.3 % reported being competent. Participants were informed of the opportunity to participate in the study by e-mail. All participants that expressed interest were sent a link to access MSAP via the internet.

Instrumentation

The research design for this study involved randomly assigning the 48 participants recruited from two universities to either the guided choice (GC) treatment or the free choice treatment (FC). The independent variable was the type of MSAP training received by each group. Two versions of MSAP were used in this study. The FC group used a version of MSAP based on ALT, which allowed them to freely move between the tutorial, guided practice, and competency assessment options employing their own learning strategy. The GC group used a modified ALT version of MSAP that was programmed to guide them towards the recommended learning sequence. In this version the recommended learning sequence was displayed each time they logged in and the program required them to go to the tutorial option once before they could access the guided practice option and to use the guided practice option once before they could access the competency assessment option. After receiving these prompts, they were free to use the options in the same manner as the FC group. The primary dependent measures for this study were the participants' pre and post test competency MSAP assessment scores.

MSAP (Kelly, 2007; Kelly & Moran, 2010; Kelly, et al., 2012) has three training options: Tutorial, Guided Practice, and Competency Assessment. For this study MSAP was designed to present training on one motor skill – the underhand roll. In the tutorial the participants are taught the focal points of the underhand roll and shown video clips of the correct performance as well as common errors that participants might see when assessing each focal point of the skill. The guided practice option allows the participants to practice assessing video clips. Under the guided practice option, participants can view a given clip an unlimited number of times and in either real speed or slow motion. Then the participants assess each focal point by selecting if the focal point was performed correctly or not. After they entered their assessment, the program provides immediate feedback on the accuracy of their assessment (i.e., correct, incorrect) of each focal point and the option to view the clip again to see their errors. After every five practice clips, the participants are provided a report that summarizes their overall assessment accuracy as well at their assessment accuracy by focal point. When participants consistently demonstrate 90% competency using the guided practice option, it is recommended they take the competency assessment. In the competency assessment, the participants are shown 10 clips, from a dedicated pool of clips, of students performing the motor skill. They can only view each of these clips three times and only in real speed. After 10 clips are evaluated, participants are provided a summative report of their competency. For this study, the competency assessment could only be taken a maximum of three times and the participants were encouraged to try and get the highest score they could.

The Everyone CAN (Kelly, Wessel, Dummer, & Sampson, 2010) motor skill assessment item for the underhand roll was used for this study. This item consisted of 7 focal points that defined the key components of the skill each of which was rated on a binary scale (1 or 0) depending upon whether the focal point was correctly performed or not. The focal points used for the underhand roll were:

a. Stand with body square to target, weight evenly distributed on both feet, feet shoulder- width apart, eyes on target, ball held in palm of dominant hand at waist level in front of body.
b. Arm swings back, elbow extended, until dominant hand is behind the thigh, with trunk rotation back.
c. Arm swings forward below the shoulder until dominant hand is in front of the thigh, with trunk rotation forward.
d. Weight shift to the foot on the arm-swing side of the body during the arm swing back, and stride forward with weight shift to the foot on the opposite side of the body during the arm swing forward.
e. Ball released close to ground, bending hips and knees with trunk near vertical, palm facing forward toward target.
f. Arm follows through well beyond ball release toward the target.
g. Smooth integration (not mechanical or jerky) of the previous focal points.

Procedures

Participants were sent the URL to access MSAP and were informed they could access MSAP 24/7 for one week. When the participants logged into MSAP the first time, they read and agreed to the IRB consent form, were randomly assigned to either GC or the FC groups, and then completed a short survey designed to collect information about their experience with assessing motor skills and their comfort level using technology. Training ended after

the week-long access period or after the participants completed their third attempt at the competency assessment.

Data Collection

The first time MSAP was used by each participant, the program administered a pretest. The pretest was composed of assessing 10 clips of students performing the underhand roll. Each clip could only be viewed three times and only in real speed. No formative or summative performance feedback was provided at the end of the pretest. During the study the participants could take the competency assessment a maximum of three times. The competency assessment used the same clips as the pretest from a dedicated pool of clips and was administered in the same manner as the pretest. At the end of each competency assessment summary feedback was provided. This feedback consisted of an overall percent accuracy score as well as the percent accuracy achieved for each of the seven focal points. The participants' best competency assessment score was used as their post score. The criterion assessment ratings for evaluating each clip were determined by a panel of five motor assessment experts (Kelly, et al., 2012) prior to the study. Each expert independently rated each of the clips using repeated slow-motion and real speed analysis. The results were compiled, viewed, and discussed with the experts. After the review the experts were asked to rate the clips again which produced an overall agreement of 98% for the clips. Given that each test was composed of 10 clips and each clip was evaluated based upon 7 focal points, the maximum score that could be achieved on each test was a score of 70. The participants' scores were calculated by dividing the number of focal points assessed correctly, by 70, and then multiplying the quotient by 100.

In addition to recording the test results, MSAP was also programmed to record how many times each program option (i.e., tutorial, guided practice) was used and for how long. It also recorded the total time each participant spent using MSAP.

Data Analysis

Three research questions were addressed in this study. The first question was to confirm the effectiveness of MSAP training and to evaluate whether MSAP training produced similar findings as reported in previous studies. The second question examined whether explicitly guiding the participants toward the recommended learning sequence would improve their performance. The third question examined how the participants used the MSAP options, how this usage corresponded to their overall performance, and whether their usage patterns were consistent with ALT. To address these questions descriptive statistics were calculated for all variables used in the study. For the first two questions a three factor School (university attended) by Treatment (guided or free) by Test (pre & post) ANOVA with repeated measures was used. To answer the third question the participants' best MSAP competency score was used to stratify all the participants into three performance groups (low, middle, and high). The frequency of use and the time spent using the MSAP tutorial and guided practice options, as well as total time using MSAP were analyzed across these three performance groups using a MANOVA. Since total time was a combined variable including tutorial and guided practice time, a separate ANOVA was run on the total time using MSAP across the three groups. In addition, a step-wise regression analysis was conducted to determine if any combination of the frequency and temporal usage variables could predict post assessment performance. An alpha level of .05 was used for all statistical analyses; LSD pair-wise comparisons were used to interpret group differences, and the Eta squared was used to calculated effect sizes. SPSS 19th edition was used to perform all the statistical analyses.

Results

Descriptive statistics by school and group for the participants' MSAP pre and post competency assessments are shown in Table 1. Data were graphed and visually inspected to ensure normalicy. Homogenity of variance was tested with Levene's test of equality of error variances for both the pre ($F(3,44) = 1.507$, $p = .226$) and post ($F(3,44) = 1.598$, $p = .203$) measures. A three-way fixed effects ANOVA with repeated measures was conducted comparing the schools and treatment groups on the pre and post assessment tests. The only significant main effect found was for test ($F(1,44) = 149.28$, $p = 0.000$) indicating that the participants' overall performance significantly improved from the pretest to the post test. The non-significant main effect for school ($F(1,44) = .103$, $p = 0.750$) indicated that there was no difference between the performances of the participants from the two universities. The main effect for treatment ($F(1,44) = 3.08$, $p = 0.086$), while approaching significance, was not significant indicating that the participants that used the guided version of MSAP did not perform differently than those that used the free choice version. No significant interaction effects were found for treatment by test ($F(1,44) = 1.05$, $p = 0.312$), school by test ($F(1,44) = 3.40$, $p = 0.072$) or school by treatment by test ($F(1,44) = 2.33$, $p = 0.134$).

Table 1. ***MSAP Pre and Post Competency Scores by School and Treatment Group (Guided Choice and Free Choice)***

Test	School	Group	N	Mean	Std. Deviation
Pre	1	GC	15	62.87	13.39
		FC	14	50.36	6.42
		Total	29	56.83	12.22
	2	GC	10	51.90	10.52
		FC	9	51.89	6.99
		Total	19	51.89	8.78
	Total	GT	25	58.48	13.27
		FC	23	50.96	6.53
		Total	48	54.88	11.15
Post	1	GC	15	79.73	10.71
		FC	14	78.21	13.28
		Total	29	79.00	11.83
	2	GC	10	83.30	7.97
		FC	9	81.11	12.08
		Total	19	82.26	9.90
	Total	GC	25	81.16	9.69
		FC	23	79.35	12.63
		Total	48	80.29*	11.11

*The overall pre to post change was significant p <.05

Finding no significant school or treatment main effects the total sample was combined and then stratified by their post competency assessment scores to form three performance groups: low (cut-off score ≤ 77) performance group (LPG), middle (cut-off score ≤ 87) performance group (MPG), and high (cut-off score >88) performance group (HPG). The performance groups were compared on their MSAP usage in terms of their frequency of use of the tutorial and guided practice options and time spent using the tutorial and guided practice options as well as the total time spent using MSAP. Descriptive statistics for the performance groups MSAP usage are shown in Table 2. The MANOVA analysis of the MSAP frequency and temporal variables across the performance groups was significant $F(12,80) = 9.82$, $p < .000$; Wilk's $\Lambda = .164$, partial $\eta^2 = .60$. Significant univariate differences were found between the performance groups on frequency of using the guided practice option ($F(2,45) = 4.92$, $p = 0.012$, ES = .18) and time using the guided practice option ($F(2,45) = 8.32$, $p = 0.001$, ES = .27). LSD pair-wise comparisons were conducted to interpret the performance group differences on these variables. For frequency of guided practice usage it was found that HPG used the guided practice options significantly more than the LPG but not significantly more than the MPG. For the time in minutes using guided practice, the HPG significantly used this option for more time than both the MPG and the LPG, and the MPG used it significantly more than the LPG. The ANOVA results on MSAP total time usage was also significant ($F(2,45) = 8.57$, $p = 0.001$, ES = .28). For total time in minutes using MSAP, the HPG significantly used this MSAP for more time than both the MPG and the LPG and the MPG used it significantly more than the LPG. Finally, a stepwise regression analysis was conducted to determine if any combination of these variables would predict post competency performance. Total time using MSAP significantly predicted MSAP performance, $b = .526$, $t = 4.19$, $p < .000$. Total time using MSAP also explained a significant amount of variance in MSAP performance, $R2 = .277$, $F(1,46) = 17.60$, $p < .000$, $\hat{y} = 73.901 + (.142 \text{ X Total Time})$.

Table 2. ***Descriptive Statistics for MSAP Usage by Performance Group***

Variable	Group	N	Mean	Std. Deviation
Post Competency (Score)	Low	16	66.8	7.77
	Medium	16	83.8	3.41
	High	16	90.3	1.44
		Total 48	80.3	11.11
Tutorial Frequency (# times used)	Low	16	1.63	0.81
	Medium	16	2.06	1.53
	High	16	2.37	1.09
	Total	48	2.02	1.19
Tutorial Time (Minutes)	Low	16	5.06	4.79
	Medium	16	8.13	7.39
	High	16	7.31	4.87
	Total	48	6.83	5.84
Guided Practice Frequency (# times used)	Low	16	3.56	4.10
	Medium	16	8.00	6.85
	High	16	15.06*	16.27
	Total	48	8.88	11.30
Guided Practice Time (Minutes)	Low	16	13.94	13.36
	Medium	16	36.38**	25.29
	High	16	64.00***	52.99
	Total	48	38.10	39.82
MSAP Total Time (Minutes)	Low	16	19.00	14.79
	Medium	16	44.50**	27.54
	High	16	71.31***	53.45
	Total	48	44.94	41.10

*HPG was significantly ($p < .05$) better that the LPG

**MPG was significantly ($p < .05$) better that the LPG

**HPG was significantly ($p < .05$) better that the MPG & LPG

Discussion

The overall competency level of the participants on the pretest (M=56.8) is consistent with the literature indicating that preservice kinesiology majors were not proficient in assessment (Behets, 1996; Biscan & Hoffman, 1976; Hoffman & Sembiante, 1975; Imwold & Hoffman, 1983; Walkley & Kelly, 1989). The significant main effect for test in the present study supports previous studies using MSAP that reported significant pre to post assessment improvements for pre-service kinesiology majors on learning to assess motor skills (Kelly & Moran, 2010; Kelly, et al., 2012). Kelly et al (2012) found a 28.3 percent improvement (ES = .91), which is comparable with the 25.41 percent improvement (ES = .77) found in this study.

The current study compared two versions of MSAP. One version, used by the GC group, was designed to provide the participants more guidance on how to effectively use the MSAP options with the goal of increasing the efficiency of their learning. The FC group used the standard version of MSAP that gave the participants complete freedom to use any of the program options. This change was employed based on anecdotal comments from participants in previous studies that suggested that at least some of these participants spent most of their time learning by trial and error in guided practice option and did not take advantage of the guided practice feedback by using the tutorial options. The group main effect was found to be non-significance ($F(1,44) = 3.08$, $p = 0.086$), but was approaching significance. Cautiously examining this difference (See Figure 2) reveals that although the participants were randomly assigned to group, the GC began higher on the pretest (GC: M = 58.48; FC: M = 50.96) and finished only slightly higher on the post assessment (GC: M = 81.16; FC: M = 79.35) with no significant differences between groups on the pre and post measures. Overall, the GC showed a 22.68% improvement compared to a 28.39% improvement by the FC, indicating that any group effect favored the FC. These findings indicate that explicitly informing the participants in the GC of the recommended learning sequence and requiring them to use both the tutorial and guided practice options at least once before taking the competency assessment did not appear to enhance their performance compared to the FC and may have potentially hindered it. Further research is warranted to investigate whether not treating participants as adult learners and constraining their access to the program options actually hinders their performance.

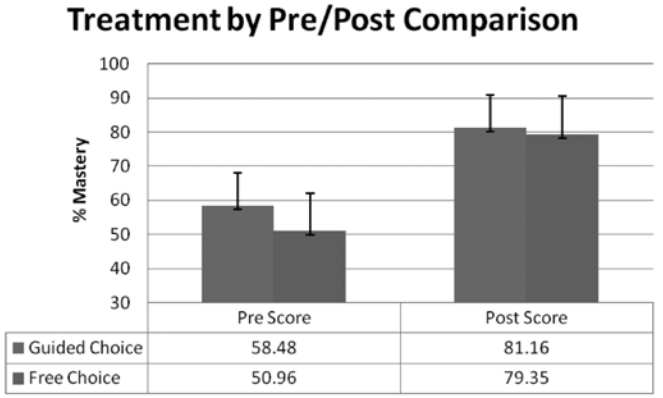

Figure 2. MSAP pre/post comparison by treatment group

It appears that forcing the participants in the GC to at least review the recommended learning sequence and use the tutorial and guided practice options once did not enhance their performance. Although the participants in the FC appear to have performed better, this does not necessarily mean they were acting like adult learners. The third question investigated in this study examined how the participants used the MSAP options and how these usage patterns corresponded with their overall performance. Not finding significant school or treatment group effects, the total sample was stratified by their post competency assessment score and divided into three performance groups of 16: low, middle, and high. The groups were then compared on their frequency and temporal usage of the tutorial and guided practice options as well as their total time using MSAP. The findings revealed that overall there was no difference between the three groups in their use of the tutorial option, which was used on average only two times and for a total of 6.8 minutes by each participant. Significant differences were found by group for both frequency and time usage of the guided practice option. The HPG used the practice option significantly more frequently than the LPG and approached significance with the MPG ($p = .063$). For time, the HPG significantly used the guided practice option for more time than both the MPG and the LPG and the difference between the MGP and LPG approached significance ($p = 0.075$). Finally, for overall time using MSAP the HPG used MSAP for more time than both the MGP and the LPG and the MPG used MSAP for significantly more time than the LPG. On a positive note, these findings indicate that participants in the HPG were able to achieve 90+% competency after using primarily the guided practice option for a little more than an hour ($M = 64$ minutes) and for the MGP to achieve 84% accuracy after only 45 minutes. These results demonstrate that the guided practice option in a trial and error fashion can produce significant gains in competency in relatively short periods of time.

The dominant use of the MSAP guided practice option is consistent with previous informal observations and anecdotal comments from past participants. The concern is that the participants are not taking advantage of the tutorial information that explicitly defines each focal point and provides video examples of the correct performance. While the current results support that one can clearly learn by just using the guided practice option, it is not the most effective means since it only focuses on identifying the participant's errors and does not show them what the correct performance should look like. After participants evaluate a clip in guided practice they receive immediate feedback on which focal points they judged as correct and which ones were judged incorrectly. They then have the option to view the clip again to see their errors.

After every five clips, they are given a summative report that indicates their overall percent accuracy as well as their percent accuracy for each focal point. For any focal point where their percent accuracy is less than 60% they are encouraged to return to the tutorial and review the correct performances and explanations with the goal of developing a better mental image of what that correct performance of the focal points should look like. Given that the participants on average only used the tutorial two times for a total of 6.8 minutes suggests that the participants were not fully taking advantage of this option to facilitate the efficiency of their learning. This is particularly noteworthy and hard to explain in light of the fact that the GC group was explicitly informed of the recommended learning sequence and had to go to the tutorial once when they initially used MSAP.

There are several other implications and recommendations for future research that can be drawn from the MSAP usage data. While the participants were acting in some ways like adult learners in that they were choosing their own learning path, from a design and learning efficiency perspective they were not taking full advantage of the program options or using the most efficient learning path. More research is needed to investigate whether this usage pattern is unique to pre-service college-aged participants and whether other groups, such as in-service physical education teachers, would use MSAP differently.

It is recommended that future studies using MSAP with both pre-service and in-service participants conduct follow up interviews and/or focus groups after the training phase to investigate what strategies the participants were actually using and to explore specifically why and how they chose to use the tutorial option. The five assumptions of ALT (Merriman, 2001; Knowles, 1977, 1980) should be used as the basis for formulating questions to determine the degree to which these different participant groups meet these assumptions. These findings should then be used to revise and refine MSAP so that it can achieve the greatest degree of competency in the shortest amount of time. This is an important consideration given the large number of physical and motor skills a physical educator must be able to competently assess.

As technology advances continue and the cost effectiveness of distance education increases, increasingly more PETE will become computer based. It is therefore important to understand how learners interact with different forms of computer delivered training so that these applications can be designed to optimally address the needs of these learners.

References

Behets, D. (1996). Comparison of visual information processing between pre-service students and experienced physical education teachers. *Journal of Teaching in Physical Education, 16*, 79-87.

Biscan, D.V., & Hoffman, S.J. (1976). Movement analysis as a generic ability of physical education teachers and students. *Research Quarterly, 47*, 161-163.

Cercone, K. (2008). Characteristics of adult learners with implications for online learning design. *AACE Journal, 16*(2), 137-159.

Cohen, P.A., & Dacanay, L.S. (1992). Computer-based instruction and health professions education: A meta-analysis of outcomes. *Evaluation Health Professions, 15*, 259-281.

Daniels, D.B. (1984). Basic movements and modeling: An approach to teaching skill analysis in the undergraduate biomechanics course. *Proceedings, 2nd National Symposium on Teaching Kinesiology and Biomechanics in Sports* (pp. 243-246). Colorado Springs, CO.

Ertmer, P.A., & Newby, T.J. (1993). Behaviorism, cognitivism, constructivism: Comparing critical features from an instructional design perspective. *Performance Improvement Quarterly, 6*(4), 50-70.

Hoffman, S.J., & Sembiante, J.L. (1975). Experience and imagery in movement analysis. In G.J.K. Alderson & D.A. Tyldesley (Eds.), *British proceedings of sports psychology* (pp. 288-293). Salford, England: British Society of Sports Psychology.

Hoffman, S. (1974). Toward a pedagogical kinesiology. *Quest, 28*, 38-48.

Horvat, M., Block, M. E., & Kelly, L. E. (2007). *Developmental and adapted physical activity assessment*. Champaign, IL: Human Kinetics.

Huang, T.H., Liu, Y.C., & Chang, H.C. (2012). Learning achievement in solving word-based mathematical questions through a computer-assisted learning system. *Educational Technology & Society, 15*(1), 248–259.

Imwold, C.H., & Hoffman, S.J. (1983). Visual recognition of a gymnastics skill by experienced and inexperienced instructors. *Research Quarterly for Exercise and Sport, 54*, 149-155.

Jenks, M.S., & Springer, J.M. (2002). A view of research on the efficacy of CAI. *Electronic Journal for the Integration of Technology in Education, 1*(2), 43-58.

Kelly, L. E. (2007). *Motor skill assessment program (MSAP)*, Charlottesville, VA: University of Virginia.

Kelly, L.E., & Moran, T. (2010). The effectiveness of a web-based motor skill assessment training program. *International Journal of Health, Physical Education, Recreation, Sport, and Dance Journal of Research, 5*(2), 53-58.

Kelly, L.E., Taliaferro, A., & Krause, J. (2012). Does computer-based motor skill assessment training transfer to live assessing? *Research Quarterly for Exercise and Sport, 83*(3), 400-406.

Kelly, L.E., Wessel, J., Dummer, G., & Sampson, T. (2010). Everyone CAN: *Skill development and assessment in elementary physical education*. Champaign, IL: Human Kinetics.

Knowles, M. S. (1977). *The modern practice of adult education: Andragogy versus pedagogy* (8th ed.). New York: Association Press.

Knowles, M. S. (1980). My farewell address...andragogy-no panacea, no ideology. *Training and Development Journal, 34*, 48-50.

Knudson, D.V., Morrison, C., & Reeve, J. (1991). Teaching kinesiology and biomechanics in sports. *Proceedings of the Third National Symposium on Teaching Kinesiology and Biomechanics* (pp. 17-20). Ames, IA: Iowa State University.

Kulik, C. C., & Kulik, J. A. (1991). Effectiveness of computer-based instruction: An updated analysis. *Computers in Human Behavior, 7*, 75-94.

Lee, T., Shen, P., & Tsai, C. (2008). Applying web-enabled problem-based learning and self-regulagted learning to add value to computing education in Taiwan's vocational schools. *Educational Technology & Society, 11*(3), 13-25.

Lounsbery, M., & Coker, C. (2008). Developing skill-analysis competency in physical education teachers. *Quest, 60*, 255-267.

McNeil, B.J., & Nelson, K.R. (1991). Meta-analysis of interactive video instruction: A 10-year review of achievement effects. *Journal of Computer-Based Instruction, 18*, 1-6.

Merriam, S. B. (2001). Andragogy and self-directed learning: Pillars of adult learning theory. *New Directions for Adult and Continuing Education, 89*, 3-13.

Nielsen, A.B., & Beauchamp, L. (1992). The effect of training in conceptual kinesiology on feedback provision patterns. *Journal of Teaching in Physical Education, 11*, 126-138.

Pinheiro, V.E.D., & Simon, H.A. (1992). An operational model of motor skill diagnosis. *Journal of Teaching in Physical Education, 11*, 288-302.

Reeve J. (2000). Qualitative analysis. Putting it all together. *Journal of Physical Education, Recreation and Dance, 71*(1), 16-17.

Walkley, J. W., & Kelly, L. E. (1989). The effectiveness of an interactive videodisc qualitative assessment training program. *Research Quarterly for Exercise and Sport, 60*, 280-285. ■